

1 **In the Claims:**

2 1. **(Original)** A method for correcting an image frame, the method
3 comprising:

4 receiving a first image frame from a digital sensor;

5 receiving a plurality of image frames from the digital sensor exposed to
6 light below a first predefined luminance level;

7 receiving a plurality of image frames from the digital sensor exposed to
8 light above a second predefined luminance level; and

9 correcting the first received image frame based on the received plurality
10 of image frames exposed to light below the first predefined
11 luminance level and the plurality of image frames exposed to light
12 above the second predefined luminance level.

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14 2. **(Original)** The method of Claim 1, wherein each image frame includes a
15 plurality of frame units and correcting includes:

16 calculating a mean value for each frame unit of the plurality of image
17 frames exposed to light below the first predefined luminance level;

18 calculating a mean value for each frame unit of the plurality of image
19 frames exposed to light above the second predefined luminance
20 level;

21 generating a second image frame by subtracting the calculated mean
22 value for each frame unit of the plurality of image frames exposed to
23 light below the first predefined luminance level from the
24 corresponding frame unit in the first image frame;

1 generating a third image frame by subtracting the calculated mean value
2 for each frame unit of the plurality of image frames exposed to light
3 below the first predefined luminance level from the calculated mean
4 value for each corresponding frame unit of the plurality of image
5 frames exposed to light above the second predefined luminance
6 level;
7 generating a fourth image frame by dividing each frame unit in the
8 second image frame from the corresponding frame unit in the third
9 image frame;
10 calculating an average of frame units within a predefined center section
11 of the third image frame; and
12 generating a fifth image frame by multiplying each frame unit in the
13 fourth image frame by the calculated average of the center section
14 frame units, thereby producing a corrected image frame of the
15 received image frame.

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17 **3. (Original)** The method of Claim 2, wherein generating a fifth image
18 frame includes adding a first predefined constant value.

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20 **4. (Original)** The method of Claim 3, wherein the first constant value is
21 around 150 based on sensor testing and characterizations.

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23 **5. (Original)** The method of Claim 1, wherein receiving the image frames
24 includes enhancing the image frames based on characteristics of the digital sensor.

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2 **6. (Original)** The method of Claim 5, wherein enhancing the image frames
3 includes:

4 determining a region of interest based on a masked region of the digital
5 sensor;
6 determining a standard deviation of the frame units for the determined
7 region of interest;
8 determining a threshold value based on the determined standard
9 deviation;
10 determining a mean of the frame units in the determined region of
11 interest that are below the determined threshold value; and
12 generating enhanced image frames based on the determined mean of the
13 frame units.

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15 **7. (Original)** The method of Claim 6, wherein generating enhanced image
16 frames includes:

17 determining a mean difference value based on the determined mean of
18 the frame units and a predefined coefficient; and
19 adding the determined mean difference value to each frame unit of the
20 corresponding image frame.

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22 **8. (Original)** The method of Claim 7, wherein determining a mean
23 difference value includes subtracting the determined mean of the frame units from
24 150.

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2 **9. (Original)** The method of Claim 6, wherein determining a threshold
3 value includes multiplying the determined standard deviation by a second constant
4 value.

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6 **10. (Original)** The method of Claim 9, wherein the second constant value is
7 around 6.

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9 **11. (Original)** The method of Claim 5, wherein receiving the first image
10 frame includes removing light scattering effects from a portion of the enhanced
11 image frame based upon light scattering properties.

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13 **12. (Original)** The method of Claim 11, wherein the light scattering
14 properties include light scattering effects of the frame units upon all other frame
15 units based upon distance between the respective frame units.

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17 **13. (Original)** The method of Claim 12, wherein removing light scattering
18 effects includes:

- 19 a) calculating an average value of frame units within the determined
20 region of interest;
- 21 b) generating a second image frame and by removing the calculated
22 average value from each of the frame units of the enhanced first
23 image frame;
- 24 c) separating the second image frame into a plurality of subarrays;

- 1 d) generating a total for each subarray by adding all the frame units of
- 2 the respective subarray;
- 3 e) determining a distance of a frame unit of the second image frame
- 4 from one of the subarrays;
- 5 f) determining the light scattering effect of the subarray upon the frame
- 6 unit based upon the determined distance of the frame unit from the
- 7 subarray and predetermined light scattering characteristics;
- 8 g) generating a subarray light scattering effect by multiplying the
- 9 determined light scattering effect by the generated total of the
- 10 associated subarray;
- 11 h) repeating e) - g) for all the subarrays;
- 12 i) generating a subarray effects total by adding all the generated
- 13 subarray light scattering effects;
- 14 j) generating a final frame unit by subtracting the generated subarray
- 15 effects total from the respective frame unit; and
- 16 k) repeating e) - j) for all the frame units of the second image frame.

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18 **14. (Original)** A system for correcting an image frame produced by a digital

19 sensor, the system comprising:

20 a processor including:

21 a first component configured to receive a first image frame from

22 the digital sensor, a plurality of image frames exposed to light

23 below a first predefined luminance level, and a plurality of

image frames exposed to light above a second predefined luminance level; and

a second component configured to correct the first image frame based on the received plurality of image frames exposed to light below the first predefined luminance level and the plurality of image frames exposed to light above the second predefined luminance level; and

an output device configured to output the corrected image frame.

15. (Original) The system of Claim 14, wherein each image frame includes a frame unit and wherein the second component includes:

a third component configured to calculate a mean value for each frame unit of the plurality of image frames exposed to light below the first predefined luminance level;

a fourth component configured to calculate a mean value for each frame unit of the plurality of image frames exposed to light above the second predefined luminance level;

a fifth component configured to generate a second image frame by subtracting the calculated mean value for each frame unit of the plurality of image frames exposed to dark from the corresponding frame unit in the first image frame;

a sixth component configured to generate a third image frame by subtracting the calculated mean value for each frame unit of the plurality of image frames exposed to light below the first predefined

luminance level from the calculated mean value for each corresponding frame unit of the plurality of image frames exposed to light above the second predefined luminance level;

a seventh component configured to generate a fourth image frame by dividing each frame unit in the second image frame from the corresponding frame unit in the third image frame;

an eighth component configured to calculate an average of frame units within a predefined center section of the third image frame; and

a ninth component configured to generate a fifth image frame by multiplying each frame unit in the fourth image frame by the calculated average of the center section frame units, thereby producing a corrected image frame of the received image frame.

16. (Original) The system of Claim 15, wherein the ninth component includes a tenth component configured to add a first predefined constant value.

17. (Original) The system of Claim 16, wherein the first constant value is around 150 based on sensor testing and characterizations.

18. (Original) The system of Claim 14, wherein the first component is configured to enhance the image frames based on characteristics of the digital sensor.

1 **19. (Original)** The system of Claim 18, wherein the first component is
2 configured to enhance the image frames by:

3 determining a region of interest based on a masked region of the digital
4 sensor;

5 determining a standard deviation of the frame units for the determined
6 region of interest;

7 determining a threshold value based on the determined standard
8 deviation;

9 determining a mean of the frame units in the determined region of
10 interest that are below the determined threshold value; and

11 generating enhanced image frames based on the determined mean of the
12 frame units.

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14 **20. (Original)** The system of Claim 19, wherein the first component is
15 configured to generate the enhanced image frames by:

16 determining a mean difference value based on the determined mean of
17 the frame units and a predefined coefficient; and

18 adding the determined mean difference value to each frame unit of the
19 corresponding image frame.

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21 **21. (Original)** The system of Claim 20, wherein the predefined coefficient is
22 about 150 based on sensor testing and characterizations.

1 **22. (Original)** The system of Claim 19, wherein the first component is
2 configured to determine a threshold value by multiplying the determined standard
3 deviation by a second constant value.

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5 **23. (Original)** The system of Claim 22, wherein the second constant value is
6 around 6.

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8 **24. (Original)** The system of Claim 18, wherein the first component is
9 configured to remove light scattering effects from the enhanced image frame
10 based upon light scattering properties.

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12 **25. (Original)** The system of Claim 24, wherein the light scattering
13 properties include light scattering effects of the frame units upon all other frame
14 units based upon the distance between the respective frame units.

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16 **26. (Original)** The system of Claim 25, wherein the third component is
17 configured to remove light scattering effects by:

- 18 a) calculating an average value of frame units within the determined
19 region of interest;
- 20 b) generating a second image frame by removing the calculated average
21 value from each of the frame units of the enhanced first image
22 frame;
- 23 c) separating the second image frame into a plurality of subarrays;

- 1 d) generating a total for each subarray by adding frame units of the
- 2 respective subarray;
- 3 e) determining a distance of a frame unit of the second image frame
- 4 from one of the subarrays;
- 5 f) determining the light scattering effect of the subarray upon the frame
- 6 unit based upon the determined distance of the frame unit from the
- 7 subarray and predetermined light scattering characteristics;
- 8 g) generating a subarray light scattering effect by multiplying the
- 9 determined light scattering effect by the generated total of the
- 10 associated subarray;
- 11 h) repeating e) - g) for all the subarrays;
- 12 i) generating a subarray effects total by adding all the generated
- 13 subarray light scattering effects;
- 14 j) generating a final frame unit by subtracting the generated subarray
- 15 effects total from the respective frame unit; and
- 16 k) repeating e) - j) for all the frame units of the second image frame.

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18 **27. (Original)** A computer-program product residing on a computer readable

19 medium for correcting an image frame produced by a digital sensor, the computer-

20 program product comprising:

- 21 a first computer program code component configured to receive a first
- 22 image frame from the digital sensor, a plurality of image frames
- 23 exposed to light below a first predefined luminance level, and a

plurality of image frames exposed to light above a second predefined luminance level; and

a second computer program code component configured to correct the first image frame based on the received plurality of image frames exposed to light below the first predefined luminance level and the plurality of image frames exposed to light above the second predefined luminance level; and

a third computer program code component configured to output the corrected image frame on an output device.

28. (Original) The computer-program product of Claim 27, wherein each image frame includes a frame unit and wherein the second computer program code component includes:

a fourth computer program code component configured to calculate a mean value for each frame unit of the plurality of image frames exposed to light below the first predefined luminance level;

a fifth computer program code component configured to calculate a mean value for each frame unit of the plurality of image frames exposed to light above the second predefined luminance level;

a sixth computer program code component configured to generate a second image frame by subtracting the calculated mean value for each frame unit of the plurality of image frames exposed to light below the first predefined luminance level from the corresponding frame unit in the first image frame;

1 a seventh computer program code component configured to generate a
2 third image frame by subtracting the calculated mean value for each
3 frame unit of the plurality of image frames exposed to light below
4 the first predefined luminance level from the calculated mean value
5 for each corresponding frame unit of the plurality of image frames
6 exposed to light the second predefined luminance level;
7 an eighth computer program code component configured to generate a
8 fourth image frame by dividing each frame unit in the second image
9 frame from the corresponding frame unit in the third image frame;
10 a ninth computer program code component configured to calculate an
11 average of frame units within a predefined center section of the third
12 image frame; and
13 a tenth computer program code component configured to generate a
14 fifth image frame by multiplying each frame unit in the fourth image
15 frame by the calculated average of the center section frame units,
16 thereby producing a corrected image frame of the received image
17 frame.

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19 **29. (Original)** The computer-program product of Claim 28, wherein the tenth
20 computer program code component includes an eleventh computer program code
21 component configured to add a first predefined constant value.

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23 **30. (Original)** The computer-program product of Claim 29, wherein the first
24 constant value is around 150 based on sensor testing and characterizations.

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2 **31. (Original)** The computer-program product of Claim 27, wherein the first
3 computer program code component is configured to enhance the image frames
4 based on characteristics of the digital sensor.

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6 **32. (Original)** The computer-program product of Claim 31, wherein the first
7 computer program code component is configured to enhance the image frames by:

8 determining a region of interest based on a masked region of the digital
9 sensor;

10 determining a standard deviation of the frame units for the determined
11 region of interest;

12 determining a threshold value based on the determined standard
13 deviation;

14 determining a mean of the frame units in the determined region of
15 interest that are below the determined threshold value; and

16 generating enhanced image frames based on the determined mean of the
17 frame units.

18
19 **33. (Original)** The computer-program product of Claim 32, wherein the first
20 computer program code component is configured to generate the enhanced image
21 frames by:

22 determining a mean difference value based on determined mean of the
23 frame units and a predefined coefficient; and

1 adding the determined mean difference value to each frame unit of the
2 corresponding image frame.

3
4 **34. (Original)** The computer-program product of Claim 33, wherein the
5 predefined coefficient is about 150 based on sensor testing and characterizations.

6
7 **35. (Original)** The computer-program product of Claim 32, wherein the first
8 computer program code component is configured to determine a threshold value
9 by multiplying the determined standard deviation by a second constant value.

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11 **36. (Original)** The computer-program product of Claim 35, wherein the
12 second constant value is around 6.

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14 **37. (Original)** The computer-program product of Claim 27, wherein the first
15 computer program is further configured to remove light scattering effects from the
16 enhanced image frame based upon light scattering properties.

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18 **38. (Original)** The computer-program product of Claim 37, wherein the light
19 scattering properties include light scattering effects of the frame units upon all
20 other frame units based upon distance between the respective frame units.

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22 **39. (Original)** The computer-program product of Claim 38, wherein the
23 twelfth computer program code component is configured to remove light
24 scattering effects by:

- 1 a) calculating an average value of frame units within the determined
- 2 region of interest;
- 3 b) generating a second image frame by removing the calculated average
- 4 value from each of the frame units of the enhanced first image
- 5 frame;
- 6 c) separating the second image frame into a plurality of subarrays;
- 7 d) generating a total for each subarray by adding frame units of the
- 8 respective subarray;
- 9 e) determining a distance of a frame unit of the second image frame
- 10 from one of the subarrays;
- 11 f) determining the light scattering effect of the subarray upon the frame
- 12 unit based upon the determined distance of the frame unit from the
- 13 subarray and predetermined light scattering characteristics;
- 14 g) generating a subarray light scattering effect by multiplying the
- 15 determined light scattering effect by the generated total of the
- 16 associated subarray;
- 17 h) repeating e) - g) for all the subarrays;
- 18 i) generating a subarray effects total by adding all the generated
- 19 subarray light scattering effects;
- 20 j) generating a final frame unit by subtracting the generated subarray
- 21 effects total from the respective frame unit; and
- 22 k) repeating e) - j) for all the frame units of the second image frame.

- 1 **40. (Original)** A method for removing light scattering effects from an image
2 frame generated by a digital sensor, the method comprising:
3 a) receiving a first image frame from the digital sensor;
4 b) calculating an average value of frame units within a predetermined
5 region of interest of the received image frame;
6 c) generating a second image frame by removing the calculated average
7 value from each of the frame units of the first image frame;
8 d) separating the second image frame into a plurality of subarrays;
9 e) generating a total for each subarray by adding frame units of the
10 respective subarray;
11 f) determining a distance of a subarray from a frame unit;
12 g) determining light scattering effects based upon the determined
13 distance and predetermined light scattering characteristics;
14 h) generating a subarray light scattering effect by multiplying the
15 determined light scattering effect by the generated total of the
16 associated subarray;
17 i) repeating f) - h) for processing all the subarrays;
18 j) generating a subarray effects total by adding all the generated
19 subarray light scattering effects;
20 k) generating a final frame unit by subtracting the generated subarray
21 effects total from the respective frame unit; and
22 l) repeating f) - k) for processing all the frame units of the second
23 image frame.

1 **41. (Original)** A system for removing light scattering effects from an image
2 frame generated by a digital sensor, the system comprising:
3 a processor including:
4 a first component configured to receive a first image frame from
5 the digital sensor; a plurality of image frames exposed to light
6 below a first predefined luminance level, and a plurality of
7 image frames exposed to light above a second predefined
8 luminance level;
9 a second component configured to calculate an average value of
10 frame units within a predetermined region of interest of the
11 first image frame;
12 a third component configured to generate a second image frame
13 by removing the calculated average value from each of the
14 frame units of the first image frame;
15 a fourth component configured to separate the second image
16 frame into a plurality of subarrays;
17 a fifth component configured to generate a total for each subarray
18 by adding frame units of the respective subarray;
19 a sixth component configured to determine a distance of a frame
20 unit of the second image frame from one of the subarrays;
21 a seventh component configured to determine the light scattering
22 effect of the subarray upon the frame unit based upon the
23 determined distance of the frame unit from the subarray and
24 predetermined light scattering characteristics;
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an eighth component configured to generate a subarray light scattering effect by multiplying the determined light scattering effect by the generated total of the associated subarray;

a ninth component configured to return to the sixth component until all the subarrays have been analyzed;

a tenth component configured to generate a subarray effects total by adding all the generated subarray light scattering effects;

an eleventh component configured to generate a final frame unit by subtracting the generated subarray effects total from the respective frame unit; and

a twelfth component configured to return to the sixth component for processing all the frame units of the second image frame; and

an output device configured to output the result of the twelfth component.

42. (Original) A computer-program product residing on a computer readable medium for removing light scattering effects from an image frame generated by a digital sensor, the computer-program product comprising:

a first component configured to receive a first image frame from the digital sensor; a plurality of image frames exposed to light below a first predefined luminance level, and a plurality of image frames exposed to light above a second predefined luminance level;

1 a second component configured to calculate an average value of frame
2 units within a predetermined region of interest of the first image
3 frame;
4 a third component configured to generate a second image frame by
5 removing the calculated average value from each of the frame units
6 of the first image frame;
7 a fourth component configured to separate the second image frame into
8 a plurality of subarrays;
9 a fifth component configured to generate a total for each subarray by
10 adding frame units of the respective subarray;
11 a sixth component configured to determine a distance of a frame unit of
12 the second image frame from one of the subarrays;
13 a seventh component configured to determine the light scattering effect
14 of the subarray upon the frame unit based upon the determined
15 distance of the frame unit from the subarray and the light scattering
16 effects;
17 an eighth component configured to generate a subarray light scattering
18 effect by multiplying the determined light scattering effect by the
19 generated total of the associated subarray;
20 a ninth component configured to return to the sixth component for all
21 the subarrays;
22 a tenth component configured to generate a subarray effects total by
23 adding all the generated subarray light scattering effects;

1 an eleventh component configured to generate a final frame unit by
2 subtracting the generated subarray effects total from the respective
3 frame unit;
4 a twelfth component configured to return to the sixth component for
5 processing all the frame units of the second image frame; and
6 a thirteenth component configured to output the result of the twelfth
7 component to an output device.

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9 **43. (Withdrawn)** A method for generating an image, the method comprising:
10 collecting a digital image of a designated area of the ground from a
11 sensor in an airborne vehicle;
12 correcting the collected image based on characteristics of the sensor;
13 and
14 distributing the correcting image.

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